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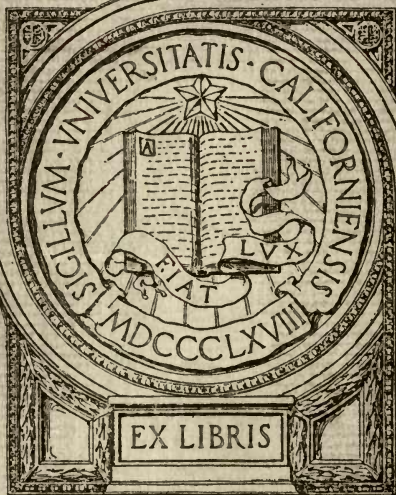
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# Grouse Disease

*Reprinted from The Times of April 19  
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By Arthur E. Shipley.

Fellow and Tutor of Christ's College, Cambridge,  
and Reader in Zoology in the  
University.



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# Grouse Disease.\*

By ARTHUR E. SHIPLEY.

*Fellow and Tutor of Christ's College, Cambridge,  
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"The longer I live, the more I am convinced that the apothecary is of more importance than Seneca; and that half the unhappiness in the world proceeds from little stoppages, from a duct choked up, from food pressing in the wrong place, from a vext duodenum, or an agitated pylorus."

Thus that incorrigible amateur-physician Sydney Smith wrote of our poor suffering humanity, and thus we can as truly write of the grouse. Little stoppages, food pressing in the wrong place, a vext duodenum, and an agitated blind-gut and there you have "Grouse disease"!

At the onset I must, however, protest against that fallacious and all-embracing expression. It will be difficult to get rid of, for the average keeper and sportsman is seldom clinically inclined and he sees his birds diseased or dead or dying and they are grouse and he is content to put it all down to "grouse disease" and to leave it at that. But grouse suffer and

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\*reprinted from *The Times*.

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die from many diseases. In a few dozen birds examined chiefly in Cambridge the following disorders were seen:—Pleuropneumonia in a bird which had lived long in captivity; pericarditis; necrotic changes in the liver; chronic diseases of the peritoneum; and a septic infection due to gangrene supervening upon a broken wing.

The disorder which is usually associated with the too comprehensive expression "grouse disease" was investigated by Klein some eighteen years ago, and in this article it will be called Klein's grouse disease. Klein found in the tissues of the bodies of birds that had been dead for some time a certain bacterium, whose nature and life history he investigated. This bacterium is now recognized as one of the *Bacillus coli* group, a widely spread group of bacteria which are found universally in the alimentary tract and which rapidly invade the tissues of the body after death. At the time Klein was working bacteriology was comparatively a new subject, and this invasion by bacteria of the tissues at the time of and after death was not appreciated.

Klein's grouse disease was associated also with some congestion of the lungs; the windpipe was described as dark in colour, the air-sacs contained blood, in the cavities of the lungs blood or some granular exudation occurred, the liver and kidneys were congested and soft, and there was an exudation on the peritoneum. We now, however, know that many, if not all, of these appearances in the chief organs of the body are but normal *post mortem* changes and occur sooner or later after death in birds which were perfectly healthy when killed. Another feature attributed to the Klein's grouse disease was that its onset was comparatively sudden, its

course rapid, and according to all observers it attacked healthy and plump birds. The present Inquiry has not yet succeeded in coming across any sick or dead birds which are plump or in good condition. All the grouse, and they amount in number to many hundreds, which have been investigated, have been weighed, and in every case where there has been any disease there has invariably been wasting; the sick birds are always thin, have lost flesh, and are in a poor condition. One final feature of Klein's grouse disease is its seasonal incidence; usually it is said to occur with greatest virulence in the spring, to die down during the summer, and to recur in a less virulent form in the autumn. To this seasonal variation I shall return.

Klein's grouse disease is still a matter of inquiry. During the last five years, whilst the Commission has been prosecuting its inquiries, this "disease" has frequently been reported, but on investigation the characteristics enumerated above have not been present; still, the sportsman and the gamekeeper, who do not weigh their grouse and seldom their evidence, and who are but imperfectly acquainted with *post mortem* changes, firmly believe in the existence of this "disease," and it may be that it really exists and that it is the misfortune of the Inquiry that in their researches the investigators have not come across it.

If we now turn from what must seem rather negative criticism to the more positive results attained by the investigation of the last four years, we may begin by pointing out some of the difficulties which confronted the Inquiry.

In considering exceptions it is so immensely important to know the rule. In studying

disease our starting-point should be the normal, the healthy ; yet until lately no one has studied the healthy grouse, and indeed it is almost impossible to find a normal grouse, *i.e.*, one free from parasites. A grouse cannot express to us its feelings ; the state of its tongue, the rate of its pulse, even its temperature tell us nothing because we have no norm and no means of estimating the extent to which a diseased bird has departed from the standards of a healthy grouse. The nature of the numerous kinds of blood corpuscles, which alter in proportion so markedly in animals when they become parasitized, was but a few months ago quite unknown, the " blood-count " uninvestigated ; in fact, the Inquiry started, as regards the cause and symptoms of the diseases which affect grouse, practically at scratch. It was, of course, known that the suffering birds lose their activity and are more easily caught than healthy grouse ; their flight is slow and limited in length ; they are said to seek water ; the " call " becomes feeble and hoarse ; the feathers of the back and throat lose their lustre and become ruffled ; the eye is dimmed. But these external symptoms may be associated with several diseases and diagnostic of none. Nearly all of them occur in the two diseases which, according to the Inquiry, are responsible for a large percentage of deaths among grouse.

Each of these diseases is caused by an animal parasite, and the investigation of the parasites attracted the attention of the scientific members of the Inquiry from an early date.

Five years ago we knew two internal parasites of the grouse (endoparasites) and two or three parasites which live outside the skin (ectopara-



sites). At the present time we know that grouse, like other animals, have a considerable fauna living both in and on them. They are in fact not only birds, but in a small way Zoological Gardens. The scientific members of the Inquiry have recorded eight different species of insect or mite living either amongst the feathers or on the skin of the bird or in other ways associated closely with the grouse, and no fewer than fifteen animal parasites living in the alimentary canal, the lungs, or other organs. Some of these are negligible. They either exist in too small numbers or infest but a very small percentage of birds; others, however, are found in about 95 per cent. of the cases investigated and two at least are associated with grave disorders which often terminate in death.

The interest of the insects and mites which live on the skin of the bird is that they very likely form the second host of tapeworms, which undoubtedly do a certain amount of harm to the lining of the alimentary canal. There are, for instance, a couple of bird-lice, lively little creatures, which take cover amongst the small feathers—which, by the way, form their arid diet—like startled deer in the undergrowth of a forest. On a piner these bird-lice increase enormously in number, and their numbers to some extent serve as a measure of the gravity of the disease. There are also two species of a flea belonging to a *genus* which serves as the second or larval host for a tapeworm of the rat which is nearly allied to the most dangerous tapeworm of the grouse, but the fleas do not seem to be common, and we have not yet succeeded in finding in them the larval tapeworms we sought. There is, further, a

tick, the common rice or dog tick, usually attached below the jaw of the bird or to the eyelid or to some other position where the beak cannot reach it. Ticks are responsible for the transference of a very fatal epizootic termed *Spirillosis* in fowls in the Sudan, but ticks are not common on the grouse, and the Inquiry has as yet traced no disease to them. Curiously enough a common cheese or flour mite was from time to time found in considerable numbers on the skin of the grouse, and apparently these mites sucked the blood of their host. Finally, there are a couple of true flies, the well-known grouse fly which is apt to crawl up the sleeves of those who handle grouse in the early autumn, and one other fly whose larva lives in grouse droppings. All these creatures have been carefully searched for the larva of the grouse tapeworms, but so far with no definite success.

Of the fifteen endoparasites but four or five demand attention ; the others are comparatively rare or innocuous, and some, such as the gape—or forked—worm so fatal to pheasants, are not normally parasites of the grouse ; by some accident they have got into the wrong Paradise.

At the time the present Inquiry commenced to inquire there were but two worms described as being in the alimentary canal of the grouse—the large tapeworm which lives in the small intestine all the year round, known to every sportsman, and a slender threadworm which inhabits the paired caeca, or blind-guts, which are unusually large in the grouse and play a very important part in its digestion. The latter worm under certain conditions, and when present in considerable numbers, is associated

with one of the two diseases which have especially attracted the attention of the Inquiry.

But besides the large tapeworm (*Davainea urogalli*), which was described by Baird fifty-seven years ago and the thread or round worm (*Trichostrongylus pergracilis*), described by Cobbold thirty-seven years ago, we have two other species of tapeworm, one negligible, the other the transparent tapeworm (*Hymenolepis microcps*), and the last-named seems also to some extent associated with disease. These worms, like the larger species, may exist in incredible numbers in the small intestine; yet they are quite invisible whilst alive. The contents of the alimentary canal in this region resemble a thick *purée*, which, on the addition of some fixing reagent, resolves itself into an inextricable tangle of fine threads, each representing a tapeworm. The head of these worms is hidden away in the folds of the lining mucous membrane of the alimentary canal, and undoubtedly they do something to interfere with its continuity. A certain amount of inflammation is set up.

It is curious to note that this tapeworm disappears during the winter months, a fact which may afford some hint as to its second host. The large tapeworms, on the other hand, remain all the year round and must be of quick growth, for they are found 35cms. in length in a young grouse but three weeks old. Here it may be remarked that, contrary to what is usually believed, the diet of the young bird is almost exclusively an insect one; it is not till they are three or four weeks old that grouse turn vegetarian. Three other round worms have also been shown to exist in the grouse. One of these in the duodenum may prove of importance. This species (*Trichosoma longi-*

*colle*) is allied to a form which lives in the human appendix, and at times is the cause of appendicitis.

Beside the worms we have in the grouse seven distinct unicellular or protozoan parasites which live in the intestines or in the blood of the grouse. Most of these are uncommon and comparatively harmless, but one, a *Coccidium* (there is no more popular word for it), is the cause of disease in the grouse chicks.

The disease—we may call it Coccidiosis for short—caused by this species of *Coccidium* (*Eimeria avium*) is brought about in this way. The grouse moor is simply peppered over with millions of oval cysts, or capsules, which represent the free-living stage in the life history of the *Coccidium*. Each cyst is very resistant to changes of temperature and moisture, and can live for a long time. The cysts pass with the food or the water or the grit into the alimentary canal of the bird, and in the duodenum the thick cyst wall is dissolved and four spores emerge. Each of these spores enters one of the cells lining this part of the intestine and destroys it. Now, when one reflects on the thousands of cysts which are at times taken up by the grouse, one can readily understand that the presence of these spores boring into the epithelial cells ultimately destroys the lining of the duodenum, where in fact the most active digestive processes are carried on in the normal bird. Furthermore, the *Coccidia* multiply in the intestine, and the resulting progeny attack new regions of the alimentary tract, especially the caeca. After a time some of them produce small forms (males), and others change into large forms (females); these two forms fuse, and the resulting stage



is the cyst mentioned above, which, passing from the body, infects the whole moor. There are many details omitted in this short abstract of the complicated life history of this parasite, which have been worked out in the grouse by Dr. Fantham at Cambridge; but enough has been said to show the nature of the disease, which is well known to occur in several other animals. There is a Coccidiosis of the rabbit, and a very fatal form attacks pigeons, fowls, and pheasants, and the grouse Coccidium if administered to chickens will set up the disease in fowls.

As a rule grouse are most susceptible to Coccidiosis during the first six weeks of their life, and if they can survive the dangers of this period they usually grow up. The chief external symptom of the disease is diarrhœa, the legs show weakness, and the feathers, especially around the legs, are in poor condition, flight is feeble, and the bird loses weight. Internally the alimentary canal is inflamed and digestion greatly impaired; perityphlitis is set up around the caeca, which become greatly enlarged. The blood corpuscles also undergo marked alteration, and an anæmic condition prevails. Further, the destruction of the lining wall of the alimentary tract allows the escape of bacteria which are all very well in their place—*i.e.*, the cavity of the intestine—but which are apt to set up trouble when they make their way into other tissues. This is, however, but a subsidiary matter; the real injury caused by the Coccidium is the destruction of the lining membrane of the alimentary canal.

Coccidiosis may be spread from moor to moor by the agency of flies. The maggots of certain flies readily eat the cysts, and it has

been shown both experimentally and on the moor that the cysts pass through the bodies of both maggot and fly undigested and unharmed.

The second disease which the Inquiry has found responsible for grouse epizootics observed between 1905 and 1910 is one to which Cobbold drew attention in 1873, though he attempted little in the way of pathological investigation. According to him it is caused by the presence of a round worm now known as *Trichostrongylus pergracilis*, in the caeca. We may call the disease "Strongylosis of the grouse." The worms are minute, transparent, very slender, a little less than half an inch in length, and they may exist in enormous numbers, 10,000 occurring in the two caeca of one bird. They are about equally divided between the two blind-guts. We may recall the fact that in the grouse the caeca are of unusual size, and that in these birds the digested food is absorbed in this region of the alimentary canal alone.

Birds heavily infected with *T. pergracilis* show an inflammation of the walls of the caeca, the contents consist of dry masses very adherent to the walls, and to these hard masses at one end and to the mucous lining at the other the worms adhere. It appears as if these masses have been for long retained in the caeca without either being absorbed or passed along. The ridges of the inside of the caeca are found to be thickened, especially in the neighbourhood of these dry masses. The villi are swollen or wasted; in some cases the lining membrane, normally smooth, resembles, when seen under a microscope, masses of coral. Sections through the caeca in badly infected birds show

a disappearance of the fat which in normal birds is there ; a great increase in amount and in the density of the connective tissue ; a dilatation of the blood-vessels, which have further unduly increased in number. Many cells, inflammatory in character, also appear. In fact we have, as Dr. Cobbett and Dr. Graham Smith, who have so ably worked out the pathology of Strongylosis, and whose results will shortly appear in the *Journal of Hygiene*, say, "a chronic inflammation leading to fibrosis." This portion of the alimentary canal is both "vext" and "agitated."

But the presence of these worms, and also, I believe, to a minor extent the presence of the transparent tape-worm in the duodenum, has a further and indirect ill-effect on the grouse. When hand-reared birds which were free from *T. pergracilis* were investigated, practically no bacilli were found in the liver or other tissues of the grouse. When the birds harboured from 100-1,000 roundworms, bacilli occurred in the tissues of about 50 per cent. of the birds—bacilli let out from the cavity of the intestine "by a worm's pin-prick," to quote Browning's "Lovers' Quarrel." When over 1,000 or more worms were present, the bacilli, with one exception, were found in the liver and in other organs of the body in 100 per cent. of the birds investigated. The exact relation of these bacilli to the sickness of the bird is still a matter of inquiry. It seems as if they are soon absorbed, and that no specific disease is traceable to them, but if they exist in numbers their products must exert a harmful influence. More inquiry is here wanted.

How does the roundworm get into the grouse ? Between 95 and 100 per cent. of birds on

different moors contain these worms. There may be as many as 10,000 in round numbers in one grouse, about equally divided between the true caeca. Each female worm lays hundreds of eggs, which are constantly passing out of the bird's body and lie scattered all over Scotland. These eggs give rise to larvæ in about two days, the larvæ surround themselves about the eighth day with a capsule or cyst, and undergo "a rest cure." After a period of quiescence they quickly change into a second and active larval form, which in wet weather—a not unusual atmospheric condition in Northern Britain—writhe and wriggle and creep and crawl until they attain the stem and the leaves and the flowers of the heather. Here these larvæ wait patiently until a grouse consumes them with the heather tips, and then, once inside the alimentary canal, they become adult, make their way to the caeca, and in four days ripe eggs are again infesting the moors.

It is recorded that Prince Bismarck once said to Lady Randolph Churchill, "Have you ever sat on the grass and examined it closely? There is enough life in one square yard to appal you."

It has always seemed to me a strange thing for the Prince to have said. To begin with, throughout his long life he had shown but an imperfect sympathy with the lower Invertebrata, and then, again, he was a man not easily appalled: but the saying is perfectly true. It is difficult for the layman to grasp what is going on in and on the soil and on the plants which it supports. Suppose we could by means of a gigantic lens magnify a square yard of a grouse moor one hundred times. The



heather plants would be as tall as lofty elms, their flowers as big as cabbages, the grouse would be about six or seven times the size of "Chantecler" at the Porte St. Martin.

Creeping and wriggling up the stem and over the leaves and gradually yet surely making their way towards the flowers would be seen hundreds and thousands of silvery-white worms about the size of young earthworms. Lying on the leaves and on the plant generally would be seen thousands of spherical bodies the size of grains of wheat, the cysts of the *Coccidium*, and on the ground and on the plants as large as split-peas would be seen the tapeworm eggs patiently awaiting the advent of their second host. It is perhaps a picture which will not appeal to all, but yet it represents what unseen and unsuspected is always going on on a grouse moor.

Two other points remain, the seasonal character of the disease, and whether any means can be suggested to check either *Coccidiosis* or *Strongylosis*, or both.

"Grouse disease" is always said to be at its worst in the spring months, to decline during the summer, and to recrudescence in a milder form in the autumn. *Coccidiosis* undoubtedly is a spring disease; it attacks the chicks, and if they survive the first six or seven weeks of their life they usually live to grow up. This disease certainly abates during the summer, but it does not recrudescence during the autumn. *Strongylosis* also occurs most virulently in the spring, when the birds are exhausted by a winter of semi-starvation and the female especially by the demands made on her by egg-laying; it is also prevalent in autumn, but the worst cases have by this time presumably

been killed off, and those not so heavily afflicted are still struggling to survive. It is not as a rule reported during June and July, but very few know what happens on the moor during these months. The grouse are almost unseen, their state of health unknown. This again is a matter for further inquiry, but at present the view that "disease" dies down during the summer has little but negative evidence to support it. It probably lingers on, gradually lessening in intensity until the near approach of August 12 again attracts the attention of the moor owner and the sportsman to his birds.

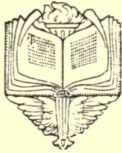
With regard to the prevention of the disease, a hopeful view can be taken. Intelligent management has already diminished and in certain cases almost, if not quite, eliminated the danger of disease, and this without resort to outside aid or scientific advice. There is reason to hope, with a clearly defined objective and a more general realization on the part of moor owners not only of the immediate cause of grouse disease, but also of the contributory conditions leading thereto, that the best methods which obtain at present in moor management will be more widely adopted, and that the suggestions of new lines of experiment which will be put forward in the final Report will be followed up.

As to the stay of the disease when fully established in the bird no practical remedial measures can at present be suggested. The apothecary is to the sick bird of no more importance than Seneca. Nothing can be done "*pour soulager les entrailles*" of the patient.

One word of conclusion to recall the fact that the Grouse Inquiry has not issued its final Report, and this article cannot represent

its final findings ; research is still going on. All I have attempted to do is to summarize the existing knowledge of the diseases of the grouse, which have never before been so specifically defined. When the final Report is published remedial measures will be suggested. This Report will also contain chapters on moor management, on the economics of grouse-shooting, on the life-histories of the many parasites associated with the grouse, and on many other matters connected with the well-being of the bird.

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